

METHOD FOR PREVENTING PHOTOOXIDATION OR AIR OXIDATION IN  
FOOD, PHARMACEUTICALS AND PLASTICS

CROSS-REFERENCE TO RELATED APPLICATIONS

This application claims priority over provisional patent application U.S. Serial No. 60/156,130, filed September 27, 1999.

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STATEMENT REGARDING FEDERALLY SPONSORED  
RESEARCH OR DEVELOPMENT

Not applicable.

BACKGROUND OF THE INVENTION

- Milk, chocolate, butter, and other foods, when exposed to light, such as sunlight or fluorescent light, may develop a characteristic off-flavor caused by photooxidation or air oxidation. This tendency to develop an off-flavor significantly reduces the shelf-life of foods susceptible to photooxidation or air oxidation. Photooxidation or air oxidation can also cause plastics to develop undesired characteristics over time, and reduce the stability of pharmaceuticals.
- 15 There is a need in the food, plastics, and pharmaceutical industries for a method of reducing photooxidation or air oxidation in susceptible materials.

BRIEF SUMMARY OF THE INVENTION

- The present invention includes a method for reducing photooxidation or air oxidation in susceptible materials, such as foods, plastics, and pharmaceuticals, comprising the step of mixing with the material an anti-photooxidation composition comprising at least one amino acid and at least one metal ion, the composition added in an amount sufficient to reduce photooxidation or air relative to a photooxidation- or air oxidation-susceptible

material lacking the anti-photooxidation composition. Preferably, the anti-photooxidation composition further comprises at least one organic acid.

Other features, objects and advantages of the present invention will become apparent to one of skill in the art after review of the specification and

5 claims.

#### BRIEF DESCRIPTION OF THE SEVERAL VIEWS OF THE DRAWINGS

Not applicable.

#### DETAILED DESCRIPTION OF THE INVENTION

- As described in the examples below, adding an antioxidation
- 10 composition comprising a carboxylic acid, a metal ion, and a compound comprising an amino acid or an amino acid moiety (hereinafter referred to as an "amino acid compound" to products, such as foods, plastics and pharmaceuticals (preferably milk or white chocolate), prevents the formation of an off flavor caused by photooxidation or air oxidation of these foods.
- 15 By an "amino acid compound" it is meant an amino acid, polypeptide or protein.
- By "antioxidation composition" as it is used herein, it is meant a composition that reduces the adverse effects of photooxidation or air oxidation when incorporated into a material that is susceptible to
- 20 photooxidation or air oxidation.
- In another embodiment, an antioxidant composition comprising an amino acid compound and a metal oxide, such as aspartate and MgO, which are capable of forming a light-absorbing complex, is used to prevent photooxidation or air oxidation in a food or other material susceptible to such
- 25 oxidation. An example of a composition having at least one metal ion and at

least one amino acid that we predict will be suitable for preventing photooxidation or air oxidation is provided below.

The examples below show that the method of the invention prevents photooxidation and air oxidation in foods susceptible to such oxidation. We  
5 expect that the method of the invention can also be used in pharmaceuticals and plastic to prevent the adverse effects caused by these types of oxidation.

As described in the examples below, the amino acid compound, carboxylic acid and metal ion may be formulated as an antioxidation composition that is added to photooxidation or air oxidation susceptible material. One of ordinary skill in the art would appreciate that although these  
10 components may most conveniently be added as a stabilizing composition, one could also add these components separately to the susceptible material.

In the examples below, lysine was used as the amino acid to promote prevent photooxidation or air oxidation. It is expected that either D-lysine or L-lysine may be used in the practice of the present invention. It is also expected that any amino acid may be used in the practice of the invention. It is reasonably expected that polypeptides and proteins may also be used together with a metal ion, or a metal ion and a carboxylic acid, to prevent photooxidation or air oxidation.  
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20 Malic acid and citric acid were used in the examples below to prevent photooxidation or air oxidation. It is expected that other carboxylic acids including mono, di, tri, and polycarboxylic acids may work equally well. It is also expected that carboxylic acids containing additional functional groups such as  $NH_2^-$ ,  $OH^-$ ,  $PO_4^{3-}$ , and  $SO_4^{2-}$  would work as well.

25 In the examples, below magnesium, magnesium and calcium, or magnesium, calcium and zinc were tested and were found to be suitable metal ions in the practice of the present invention. Other metal ions are

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expected to work as well, including group IA, group IIA, Ti, V, Cr, Mn, Co, Ni, Cu, Zn, Se, Fe, Mo, Sn, and Au.

The molar ratio of the metal ion to amino acid compound to carboxylic acid may vary depending upon the application. The molar ratio of the amino acid compound to the metal ion may vary from about 0.01 to about 20 when the amino acid compound is an amino acid monomer. The carboxylic acid to metal ion molar ratio can vary from about 0.01 to about 20. Preferably the molar ratio of the amino acid to metal ion varies from about 0.1 to about 4, and the molar ratio of carboxylic acid to metal ion varies from about 0.1 to 10 about 4. Preferably a suitable antioxidation composition comprises at least one amino acid compound, at least one carboxylic acid and at least one metal ion, and has a pH in the range of 3 to 8.

In another embodiment of the present invention, the composition also reduces color fading in materials selected from the group consisting of food, plastics, flowers and paper. One cause of color fading is due to UV light interaction with the dyes and pigments comprising functional groups such as alcohol, ester, aldehyde, ketones, ether, and carboxylic acid resulting in breakdown of the dye and pigment color. The compositions of amino acid, metal and organic acid can reduce and/or prevent the breakdown of dye or pigment color by two methods. In one method, the composition adsorbs UV light that can interact with the dye and pigment and emit white light. This absorption will prevent the UV light from interaction with the functional groups of the dyes or pigments. In the second method, the functional groups and metals of the composition can stabilize the functional groups of the dyes and 20 pigment by forming chelated bonds and/or hydrogen bonds. This will help 25 prevent UV light from breaking down the dyes and pigments.

The composition can be blended or applied to the surface of a product, such as food, plastic flowers, and paper, to reduce and/or prevent the UV

light from interacting with the dyes and pigments. We usually observed that the fading of the material comprising the composition of amino acid, metal and organic acid to be less than the fading of untreated material without the composition.

5 In another embodiment of the present invention, the composition also reduces degradation of a substance selected from the group consisting of caffeine, vitamins (preferably pyridoxine, riboflavin, vitamin D, niacin, phylloquinone), folic acid, isoflavones, licorice, ginkgo, garlic, beta-carotene, peppermint, herbal extract, botanicals, peppermint, herbal extract, botanicals, 10 natural and artificial flavors. The materials described above have functional groups such as alcohol, ester, aldehyde, ketones, ether, and carboxylic acid, that can interact with metal and functional groups of the composition of amino acid, metal and organic acid. Some of the interaction are hydrogen bonding and chelation. Drinks were prepared with vitamins and flavor with and without 15 the composition of amino acid, metal and organic acid. The drinks were pasteurized. The drinks were then taste tested, and the drinks with the composition had an overall better taste.

In preferred embodiment, the product is milk or white chocolate and the level of the composition is between 0.001% and 2% w/w (Note: all 20 percentage concentrations are w/w).

*Sub A* ~~In a most preferred embodiment, the product is milk, the range is 0.01% to 0.5%, and the composition is 65% solid solution of lysine:mg:malic:citric with a molar ratio of 1.49:1.2:16:0.72.~~

*Sub A2* ~~In another embodiment, the product is white chocolate, the range is 25 from 0.1% to 0.5%, and the composition is lysine:ca:malic:citric with a molar ratio of 1.49:1:2:16:0.72, which is a crème.~~

In another embodiment, the product is plastic and the level of the composition is from 0.001% to 5%, preferably 0.01% to 2%.

The following non-limiting examples are intended to be purely illustrative.

## EXAMPLES

### Preparation of antioxidation compositions

- 5        The following are examples of antioxidation compositions that may be used to protect products, such as food, pharmaceuticals, and plastics, against photooxidation or air oxidation.

10                  Composition A  
160 g water  
110 g lysine HOH (0.67 moles)  
40 g MgO (0.99 moles)  
130 g malic acid (0.97 moles)  
62 g citric acid (0.32 moles)

The pH of the solution varies from 4.4 to 4.8 and is approximately 65%  
15 solid solution.

20                  Composition B  
157 g water  
110 g lysine HOH (0.67 moles)  
10 g CaO (0.18 moles)  
18 g MgO (0.45 moles)  
100 g malic acid (0.75 moles)  
73 g citric acid (0.38 moles)

The pH of the solution varies from 3.9 to 4.3 and is approximately 65%  
solid solution.

25                  Composition C  
166.4 g water  
143 g lysine HOH (0.87 moles)  
13 g CaO (0.23 moles)  
13 g MgO (0.32 moles)  
30                  13 g ZnO (0.16 moles)  
122.2 g malic acid (0.91 moles)  
58.5 g citric acid (0.30 moles)

The pH of the solution varies from 4.2 to 4.6 and is approximately 65%  
solid solution.

35                  Composition D  
1571.5 g water  
1155.1 g lysine HOH (7.03 moles)  
189.1 g MgO (4.69 moles)

1365.1 g malic acid (10.18 moles)  
654.6 g citric acid (3.41 moles)

The pH of the solution varies from 3.6 to 4.0 and is approximately 65% solid solution.

- 5           Composition E  
10 g water  
10 g lysine HOH (0.061 moles)  
40 g MgO (0.060 moles)  
7.2 g succinic acid (0.061 moles)
- 10          The pH of the solution varies from 8 to 9.
- 15          Composition F  
15 g water  
8.2 g DL-aspartic acid (0.062 moles)  
2.5 g MgO (0.062 moles)
- 15          Compositions A-F may be used as a liquid as prepared, or may be used as a solid after drying by any suitable means, including, for example, microwave, spray dried, drum dried, and any other feasible process, such as fluid bed agglomeration and cooker extrusion.

Evaluation of milk stability after exposure to light

- 20          The following samples were prepared, exposed to light and evaluated as described below.

Control

A 200-ml aliquot of whole milk in a clear container wrapped in aluminum foil.

- 25          Sample 1  
A 200-ml aliquot of whole milk in a clear container.  
Sample 2  
A 200-ml aliquot of whole milk and 2 grams of composition B.  
The control and test samples were exposed for two hours and 10 minutes to a Sylvania Superflood light (blue bulb) placed at a distance of 11 inches from the container. The control and test samples were evaluated by tasting.

No off-flavor was noted in the control. Sample one had an off taste, similar to that of sour milk. Sample two tasted comparable to the control.

Evaluation of white chocolate stability after exposure to light

The following samples were prepared, exposed to fluorescent light and  
5 evaluated as described below.

Control

White chocolate not exposed to light

Sample 1

White chocolate exposed to light

10           Sample 2

White chocolate blended with composition A (0.2% w/w) and exposed  
to light

Sample 3

White chocolate blended with composition B (0.2% w/w) and exposed  
15          to light

Sample 4

White chocolate blended with composition C (0.2% w/w) and exposed  
to light

Sample 5

20          White chocolate blended with composition D (0.2% w/w) and exposed  
to light

Each sample was exposed to light for several hours to days and  
sampled periodically for taste tests. The chocolate comprising anti-  
photooxidation composition A, B, C, or D had a flavor comparable to the  
25 control, whereas the untreated white chocolate (sample A) had an off flavor.  
Sample C, which comprises composition B, had a flavor closest to the control.